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THE LOCUST BORER[1] AND METHODS FOR ITS CONTROL.

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The locust borer and its relation to detrimental and destructive injuries to the black or yellow locust[2] in the eastern United States have been subjects of special investigations by the Bureau of Entomology during the past two years, which have resulted in the determination of practical methods of control.

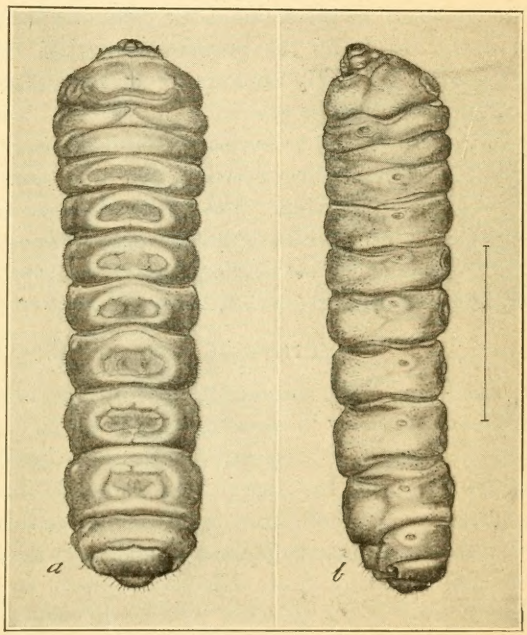

FIG. 1.—The locust borer (*Cyllene robiniæ*): *a*, larva, dorsal view; *b*, same, lateral view. Line at right represents natural length (author's illustration). The larva in profile should show minute prothoracic feet.

The locust borer is a whitish, elongate, so-called "round headed" grub or larva (fig. 1), which hatches from an egg (fig. 2) deposited by a black or brown and yellow striped long-horned winged beetle (fig. 3) found on the trees and on the flowers of golden-rod from August to October. The eggs are deposited in the crevices of the bark of living, growing trees from August to October, and the young borers (fig. 2, *b*, *c*) hatching therefrom excavate individual cells in the outer layers of the inner living

[1] *Cyllene robiniæ* Forst; Order Coleoptera, Family Cerambycidæ.
[2] *Robinia pseudacacia.*

bark (fig. 4), where they pass the winter, and in the spring bore through the bark into the sapwood and heartwood. Here they transform in July and August to pupæ and in August and September to adult beetles, which soon emerge from the trees and deposit eggs for the next annual generation of borers and beetles.

The injury to the trees consists of wounds in the bark and sapwood which, if sufficiently severe or repeated year after year, result in either a stunted, worthless growth or the death of young and old trees, while the numerous worm holes in the wood reduce its commercial value or render it worthless.

The presence of the insects in injurious numbers is indicated (1) by the frequency of the adults on the golden-rod flowers and on the trees from the last of August until in October or later; (2) by the slight flow of sap and by the brownish borings where the young larvæ are at work in the bark during April; (3) by the yellowish borings lodged in the rough bark, in the forks of the tree, and on the ground around the base of the trunk, by the breaking down of the branches and young trees, and by the sickly appearance of the young twigs and leaves during May, June, and July.

This insect appears to be present and more or less injurious in all of that part of the United States which is east of the Great Plains and north of the Gulf States. Published information and reports of forest officials and others indicate that in Oklahoma and Indian Territory and west of the Great Plains the locust is now quite free from injury by the borer, but that these regions will remain exempt is by no means certain.

EXTENT OF DAMAGE AND LOSS.

So extensive is the damage to natural growth, artificial plantations, and shade trees that in some sections within the natural range of the tree in the Eastern States, but particularly in the Middle West, where both the tree and the insect have been introduced, it is considered unprofitable to grow the tree for shade or timber, and in such sections the natural sprout growth is often considered a pest rather than otherwise.

The loss resulting from defective timber, stunted growth, and the death of trees is represented by the difference in value between the damaged growth, or product, and the same if uninjured and healthy. This, if expressed in dollars, would represent a large sum.

CHARACTER OF THE INJURIES.

The destructive nature of the work of the locust borer is a matter of great economic importance. The borer attacks the otherwise perfectly healthy trees, and in addition to causing the detrimental worm-hole defects in the wood, it often kills the trees or renders an otherwise valuable product worthless except for fuel. It is much more destructive in some localities and sections than in others, and also much more

destructive to some trees in the same grove than it is to others. It is more destructive, also, to young saplings and the branches of medium-sized trees than to the larger trees.

The death of a tree is caused principally by injuries to the inner bark and cambium resulting from repeated attacks. Injuries to the wood alone do not result in the death of trees, except when all of the wood is practically destroyed or sufficiently injured to cause the tree to fall or be broken down by the wind.

The commercial value of the wood product is diminished or destroyed by the worm-hole defects, but for certain purposes, as, for instance, fence posts, a limited number of such defects are not detrimental, except so far as they may contribute to decay.

EVIDENCES OF ATTACK.

The first evidence of attack is fine brownish boring dust and wet spots on the bark, first observed in April, when the overwintered larvæ begin to enter the inner bark. As soon as the larvæ begin to groove the surface of the wood and enter the sapwood, their presence, in addition to the wet spots, is indicated by yellowish boring dust mixed with liquids and the gum-like exudations. After all of the larvæ have entered the wood their presence is plainly indicated by the quantities of yellowish boring dust lodged in the loose bark on the trunk, in the forks of the tree or branches, and around the base. At this stage, usually about the middle of May, the badly infested trees which will die are plainly indicated by the failure of the leaf buds to open or by the dwarfed or faded and sickly appearance of the foliage and, toward the last of the month until the larvæ have completed their work in July, by the breaking down of the branches and small trees.

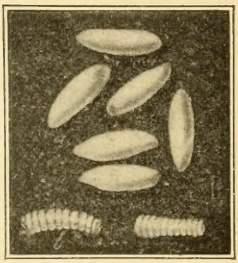

FIG. 2.—The locust borer (*Cyllene robiniæ*): *a*, eggs; *b*, *c*, larvæ from hibernation cells. Much enlarged (author's illustration).

FAVORABLE AND UNFAVORABLE CONDITIONS FOR DESTRUCTIVE WORK.

Favorable conditions for the destructive work of the borer appear to consist in the presence of isolated trees and groves in the open, in localities where golden-rod is present or abundant and where less resistant varieties of the tree prevail.

Unfavorable conditions are found in forest growth or large areas of pure stands, or mixed stands where the locust predominates; also in plantations and groves where resistant varieties prevail and where there is no golden-rod or other favorite food for the beetles. It is also found that coarse, thick bark is less favorable than the thinner bark on old and young trees and saplings.

METHODS OF CONTROL.

It should be remembered that all the holes found in a tree and all other damage by the borer are not the work of one generation, but usually that of repeated annual attack during the life of the tree; also that a burrow in the sapwood of a young tree remains the same burrow in the heartwood of the old tree, without change, as long as the tree exists, except in the healing of the original entrance; therefore the number of borers and the annual amount of damage are not so great as they might appear, and, while the females are capable of depositing a hundred eggs each, only a small percentage of the larvæ hatching from them survive the bark-infesting stage or complete their development to adults. This suggests that any method of management which will insure the destruction of a large percentage of the surviving larvæ and beetles each year will reduce the damage to a point where there will be practically no loss.

With our knowledge of the life history and habits of the insect, it is now possible to make definite recommendations and suggestions for its control. Some of those of immediate practical importance are as follows:

TIME TO CUT LOCUST TO DESTROY THE YOUNG LARVÆ.

The cutting of locust for all purposes, including thinning operations and for private or commercial use, should be done during the period beginning with the 1st of October and ending with the 1st of April, the bark removed from the crude product, such as posts, poles, and the like, and the tops and thinnings burned. The removal of the bark from all desirable portions of the trunks of the trees felled during this period is important and necessary, in order to destroy the larvæ before they enter the wood. The work in all cases should be completed before the leaf buds begin to swell on the living trees in the spring.

DESTRUCTION OF INFESTED TREES AND WOOD.

When it is desirable simply to remove and destroy, by burning or otherwise, the badly infested and damaged trees to kill the broods of larvæ, the work should be done in May and June, when all such trees can be easily recognized by the boring dust, fading leaves, broken branches, etc., but the work must be completed before the beetles begin to emerge. Perhaps the best rule applicable to all localities, latitudes, and elevations is to complete the work by the time the flowers have all fallen from the trees, which will vary between different altitudes and latitudes from about the middle of May to the last of June. Another rule would be to complete the work before the earliest varieties of golden-rod begin to show evidences of flowering. This, however, would be the latest that the work should be done, because the beetles begin to emerge by the time the first golden-rod flowers appear.

SPRAYING THE TRUNKS AND BRANCHES TO KILL THE YOUNG LARVÆ.

Experiments have demonstrated that the hibernating larvæ may be killed by spraying the trunks and branches with a strong solution of kerosene emulsion. Therefore, when it is practicable or more desirable to adopt this method for the protection of small plantations, groves, or shade trees, the spraying should be done in the fall or winter, not earlier than November 1 and not later than April 1, or, in other words, during the dormant period of the tree. The following paragraphs explaining the preparation of the kerosene emulsion are taken from Farmers' Bulletin No. 127 of this Department, by Mr. C. L. Marlatt:

Kerosene emulsion (soap formula)—

Kerosene	gallons	2
Whale-oil soap (or 1 quart soft soap)	pound	½
Water	gallon	1

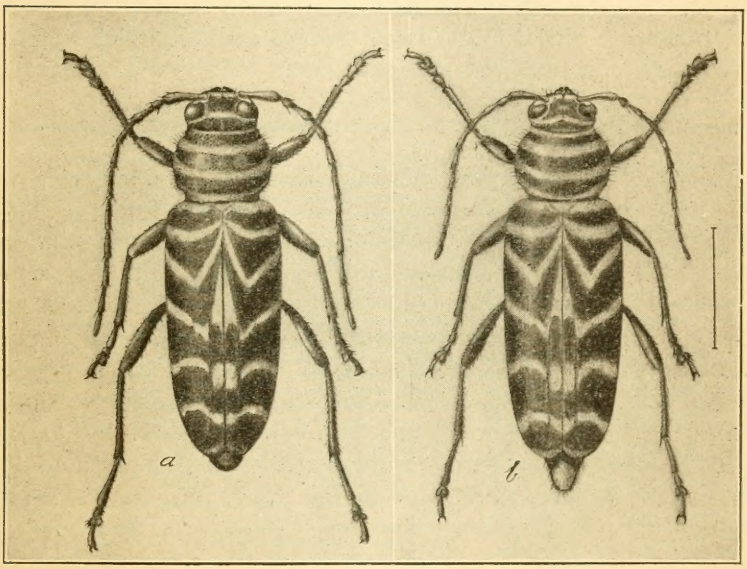

FIG. 3.—The locust borer (*Cyllene robiniæ*): *a*, male beetle; *b*, female beetle. Much enlarged (author's illustration).

The soap, first finely divided, is dissolved in the water by boiling and immediately added boiling hot, away from the fire, to the kerosene. The whole mixture is then agitated violently while hot by being pumped back upon itself with a force pump and direct discharge nozzle throwing a strong stream, preferably one-eighth inch in diameter. After from three to five minutes' pumping the emulsion should be perfect, and the mixture will have increased from one-third to one-half in bulk and assumed the consistency of cream. Well made, emulsion will keep indefinitely and should be diluted only as wanted for use.

For the treatment of large orchards or in municipal work requiring large quantities of the emulsion, it will be advisable to manufacture it with the aid of a steam or gasoline engine, as has been very successfully and economically

done in several instances, all the work of heating, churning, etc., being accomplished by this means.

The use of whale-oil soap, especially if the emulsion is to be kept for any length of time, is strongly recommended, not only because the soap possesses considerable insecticide value itself, but because the emulsion made with it is more permanent, does not lose its creamy consistency, and is always easily diluted, whereas with most of the other common soaps the mixture becomes cheesy after a few days and needs reheating to mix with water. Soft soap answers very well, and 1 quart of it may be taken in lieu of the hard soaps.

In limestone regions or where the water is very hard some of the soap will combine with the lime or magnesia in the water, and more or less of the oil will be freed, especially when the emulsion is diluted. Before use, such water should be broken with lye or rain water employed. * * *

For use on locust trees dilute 1 gallon of emulsion with 2 gallons of soft water.

Pure kerosene and pure petroleum will effectually kill the insects, but may do some damage to the bark of the trees.

Experiments with carbolic emulsion indicate that this preparation is of no value to kill the young larvæ.

DAMAGE TO CUT WOOD AND DANGER OF INTRODUCTION INTO NEW LOCALITIES.

We have determined that after the borers have once entered the wood they may complete their development in the cut and dry branches. They will evidently do so, therefore, in posts or other material manufactured from trees cut between the first of May and the middle of September. From this it is plain that locust should not be cut during that period for any purpose except to destroy the borers, or, if it should be necessary to cut it, the tops should be burned and the logs submerged in ponds or streams for a few days before they are shipped or manufactured. This is very important, both to prevent further damage to the manufactured material by the borers remaining in the wood and also to prevent the introduction of the insect into the Far West and other sections of the country which are at present free from it.

SELECTION OF LOCATIONS FOR EXTENSIVE PLANTINGS.

The fact that there are many sections and localities of greater or less extent within the natural home of the locust and its insect enemies where, from some unknown cause, the tree grows to large size and old age without perceptible injury from borers and other insects suggests the importance of selecting such localities for any proposed extensive operations in the line of artificial planting or utilization of natural growth. It will be found, however, that no area of considerable extent, even in such localities, is entirely free from this and other destructive insect enemies, and that certain precautions and well-planned methods of management with reference to their control will be necessary.

MANAGEMENT OF PLANTATIONS TO PREVENT INJURY.

In the first place it is necessary, in order to provide against future losses from the borer, that a thorough survey be made in May and June, not only of the area to be utilized, but of the entire neighborhood for a radius of a mile or more from its borders, for the purpose of locating and destroying scattering trees and groves which are more or less seriously infested or damaged by the borer. It would seem that the control of such large areas, by purchase or under a plan of cooperation between the owners of the land or trees, is one of the most important requisites for success in preventing future losses from the ravages of this and other insects in small as well as large plantations. In fact, it is the writer's opinion that with this precaution properly and continuously carried out, locust may be successfully protected from the borer in any locality.

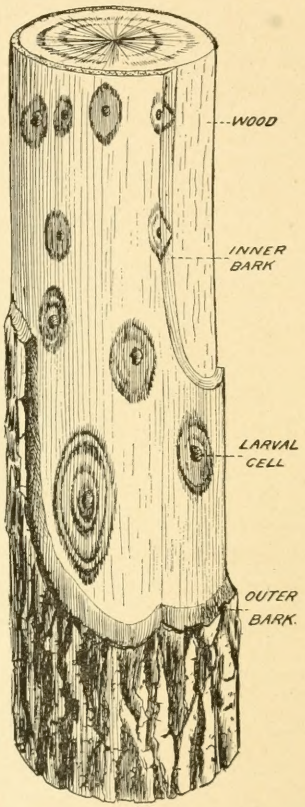

FIG. 4.—The locust borer (*Cyllene robiniæ*): Hibernation or larval cells in outer portion of living inner bark. About natural size (author's illustration).

In the subsequent management of plantations and of natural forest and sprout growth it is important each year to locate and destroy the worst infested trees for the purpose of killing the borers in the wood and to conduct the thinning and commercial cutting operations during the period between October of one year and April of the next, in order to destroy the young borers before they enter the wood.

Worthless, scrubby, borer-infested trees should be killed outright by stripping the bark from 4 or 5 feet of the lower stem during August to prevent sprouts and seed production from them and at the same time to destroy the eggs and young borers. Trees deadened in this manner will usually be so completely killed that not a single root sprout will appear. Therefore this method is of special value in preventing sprout reproduction from inferior individual trees.

BREEDING AND PROPAGATING BORER-RESISTANT TREES.

The fact that some trees are to a greater or less extent immune from attack or injury by the borer, while adjacent ones in the same grove are attacked year after year and seriously damaged, suggests the idea of

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breeding races and varieties of the species which would be permanently immune.

Breeding experiments have been begun in cooperation with the Bureau of Plant Industry and the Forest Service, but it will require several years to get definite results. In the meantime, however, it is important that seed and cuttings for commercial planting should be selected as far as possible from trees which show least damage from the borer and are otherwise vigorous and healthy. From a well-established principle in the heredity of plants and animals this practice of propagating from the best examples must certainly yield better results than would follow a disregard of the character of the trees from which seed or root propagations are made.

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *February 1, 1907.*

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